Foster entitled "Mercury loading to the San Francisco Bay ... Estuary from the Sacramento Watershed" by Foe C.G, W Croyle and D. Hinton. 18th Annual meeting SETAC 16-20 Nov'97 San Francisco

Abstract

A mercury human health advisory has been issued for the Sacramento-San Joaquin Delta Estuary recommending a restricted consumption of long lived fish including striped bass and shark. Riverine inputs are thought to be the principal source of the element. Monitoring in the Sacramento River in 1993/94 during low flow conditions (12,000-30,000 CFS) with clean hand techniques demonstrated that total mercury concentration was positively correlated with discharge at Freeport. The estimated riverine load for the nine month time period between May and December 1994 was about 20 kg.

The winter of 1995 was very wet. Metal samples were collected daily during peak flows (300,000 CFS) from both major Sacramento Valley inputs to the estuary: Sacramento River and Yolo Bypass. Mercury concentrations in the River and Bypass ranged between 10-85 and 15-700 ng/l with an estimated combined load of about 780 kg for the four month period (January to April). The high concentrations in the Bypass suggested a possible local source. Follow-up studies determined that Cache Creek was discharging mercury into the Cache Creek Settling Basin at concentrations between 400-2200 ng/l. The estimated load to the Basin between January and April 1995 was about 1,000 kg. About half this mercury was exported to the Yolo Bypass

Introduction

Mercury was historically mined in the Coast Range and transported across the Valley for use in placer gold mining in the Sierra Nevada Mountains. Both operations caused wide spread mercury sediment contamination in water courses in the Coast Range, Sierra Nevada Mountains, Valley floor and Sacramento-San Joaquin Delta Estuary. The mercury has biomagnified into the aquatic food chain and a human health advisory was issued for striped bass in 1973. The advisory was reissued in 1994 for bass caught in San Francisco Bay and extended to also include Leopard and Smoothhound shark.

Riverine inputs are believed to be the major source of estuarine mercury (Gunther *et al.*, 1987). However, information on mercury concentration and loads are believed unreliable as the early data was collected without clean hand techniques and with high detection limits. The purpose of the present study was to collect mercury concentration and load information for the largest freshwater source to the estuary, the Sacramento River, and, if possible, use this information to help identify sources.

Method and Materials

Mercury and total suspended solid (TSS) samples were collected in approximately mid channel using clean hand techniques. The process consisted of lowering a triple rinsed, acid washed 1 gallon glass bottle to the bottom and pulling it slowly back to the surface. The sample was vigorously shaken and decanted into teflon and plastic containers for mercury and TSS analysis. Travel blanks, processed in a similar manner, demonstrated that background mercury contamination was always less than 1 ng/l. Mercury concentrations were analyzed by Frontier Geosciences (Frontier Geosciences,1996). TSS was determined by filtering a known volume of water through a glass fiber filter and drying to constant weight at 103-105° C (Clesceri *et al.* 1989). River discharge was determined from the Department of Water Resources California Data Exchange Center.

Results and Discussion

Dry Weather/Low Flow

TSS and Mercury TSS and mercury samples were collected in the Sacramento River near Greens Landing between October 1993 and December 1994 (Figure 1). A positive correlation was noted between River discharge at Freeport and both mercury (Figure 2) and TSS concentration.

Loads Mercury and TSS loads were determined by multiplying the daily discharge rate of the River by the correlation equation relating flow to either mercury or TSS and summing over the time period of 1 May 1994 to 1 January 1995. The results suggest that the River transported about 20 kg mercury and 100 thousand metric tons of sediment during the nine month period (Table 1).

Wet Weather/High Flow

Hydrology Sixteen inches of rain fell in the City of Sacramento in January 1995 (Figure 3). The combined discharge of the Sacramento River and Yolo Bypass rose rapidly and peaked on 12 January at 240,000 CFS. A second storm at the beginning of March produced an additional 7 inches of rain. Again, the combined discharge from the Basin rose and peaked at 300,000 CFS on 13 March.

TSS and Mercury TSS and mercury were measured almost daily during the first storm at Greens Landing in the Sacramento River and at Prospect Slough in the Yolo Bypass (Figures 4 and 5).

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Load calculations suggest that the Basin exported about 800 kg of mercury and 4 million metric tons of sediment between 1 May 1994 and 30 April 1995 (Table 1). About 98% of the material was transported during the four month high flow period. Half the mercury and 65% of the sediment was exported through the Bypass. Our mercury load estimate appears consistent with results of a study by Larry Walker and Associates (1997) who calculated that the Sacramento watershed exported 620 kg of mercury between October 1994 and September 1995.

Cache Creek Elevated mercury concentrations in the Yolo Bypass suggested a possible local source. All local inputs, except the Sacramento River, were sampled on at least one occasion during each of the two major storms(Table 2). An accurate assessment of the contribution of the Sacramento River is impossible to make at its discharge point into the Bypass (Freemont Weir) as the Sacramento and Feather Rivers and Sutter Bypass all join immediately upstream and are not well mixed upon discharge through the weir. Therefore, each tributary was sampled individually. The highest mercury concentrations were consistently observed in Cache Creek (Table 2).

Follow up studies during 1996 and 1997 confirmed that Cache Creek was a major source of mercury. A correlation was noted between total mercury concentration at Road 102 and flow immediately upstream at the town of Yolo (Figure 6). This relationship was used to estimate a load of 1,000 kg of mercury to the Cache Creek Settling Basin between 1 January and 30 April 1995.

Comparison of mercury and TSS concentrations entering and leaving the Cache Creek Settling Basin demonstrate that the impoundment acts as a sink trapping about half the mercury and sediment at flows greater than 2,500 CFS (Table 3). In contrast, the Basin exports 3 to 4 times the amount of material entering it at flows less than 700 CFS.

Estuarine bioavailability of Cache Creek mercury is not known. However, the Creek serves as the major source of water for the recently created Yolo Wildlife Refuge. In addition, the CALFED Bay Delta program is proposing to purchase large areas downstream in the Yolo Bypass for conversion to shallow water wildlife habitat. Follow up studies are needed to ascertain whether these will act as methylating enviroments and exacerbate mercury bioaccumulation in the Estuaries aquatic food chain.

Conclusions

- Sediment and mercury loads were calculated for the Sacramento Valley for a wet year (May 1994 to April 1995). The Sacramento River and Yolo Bypass together exported about 800 kg mercury and 4 million metric tons of sediment. Ninety-eight percent of the material was transported during the four month high flow period.

- Cache Creek was identified as a major local source of mercury to the Yolo Bypass. The Creek exported about 1,000 kg of mercury between January and April 1995 to the Cache Creek Settling Basin. About half the metal was exported to the Yolo Bypass.

- Estuarine bioavailability of Cache Creek mercury is not known. However, follow up studies are needed to ascertain this as several wild life refuges are proposed for the Bypass below the confluence of Cache Creek.

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